PCRTM-SOLAR model with multiple atmospheric scattering

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The top of atmosphere (TOA) reflected solar spectrum contains extensive information on the atmosphere and the Earth's surface. However, it is very difficult to calculate the TOA radiance spectra because (i) the radiance is highly azimuthal-angle-dependent, (ii) the multiple scattering of solar light by cloud particles and/or aerosol is complicated, and (iii) the Earth's surface has a non-Lambertian nature. A Principal Component-based Radiative Transfer Model (PCRTM-SOLAR) has been developed to simulate the reflected solar spectra for both clear sky and cloudy sky conditions [1,2].

In this talk we will summarize the recent advances in developing the PCRTM-SOLAR. We will discuss how the multiple scattering of the solar beam by the multilayer clouds and aerosols is calculated using a discrete ordinate radiative transfer scheme, how the calculation time is significantly shortened by using the principal component analysis, and how the calculation time is further reduced using a hybrid stream method. We will also discuss the accuracy of the fast PCRTM-SOLAR relative to other much slower radiative transfer models, such as MODTRAN. The results indicate that the hybrid stream PCRTM-SOLAR is very efficient and accurate in simulating thousands of reflected solar spectra under multilayer cloud and aerosol conditions for climate-change Observing System Simulation Experiment (OSSE) studies and other applications.

References

[1] Liu, X., Q. Yang, H. Li, Z. Jin, W. Wu, S. Kizer, D. Zhou, and P. Yang, 2016: Development of a fast and accurate PCRTM radiative transfer model in the solar spectral region. *Appl. Opt.* **55**, 8236–8247.

[2] Yang Q., X. Liu, W. Wu, S. Kizer, and R. Baize, 2016: Fast and accurate hybrid stream PCRTM-SOLAR radiative transfer model for reflected solar spectrum simulation in the cloudy atmosphere. *Opt. Express* **24**, A1514–A1527.

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